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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/656,182	09/08/2003	Allen McTeer	M4065.0248/P248-C	8422
24998	7590	05/19/2006		
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP 2101 L Street, NW Washington, DC 20037			EXAMINER LEE, EUGENE	
			ART UNIT 2815	PAPER NUMBER

DATE MAILED: 05/19/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

11A

<b>Office Action Summary</b>	Application No. 10/656,182	Applicant(s) MCTEER, ALLEN	
	Examiner Eugene Lee	Art Unit 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 March 2006.
- 2a) ☐ This action is FINAL.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 74-80, 82 and 83 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 74-80, 82, 83 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2/23/06 has been entered.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 74, and 75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Okada 6,424,036 B1 in view of Tao et al. 5,891,802. Okada discloses (see, for example, FIG. 5) a semiconductor device comprising a protective insulating film (dielectric layer) 2, semiconductor substrate (substrate) 1, first barrier metal film (barrier layer) 14, copper pad film (copper layer) 19, and final protective insulating film (insulating layer) 16. In column 9, lines 9-10, Okada discloses the copper pad film having a thickness of 1.5  $\mu\text{m}$  or 15000 Angstroms (500 Angstroms to about 20,000 Angstroms). Okada does not disclose said copper layer having only an upper surface implanted with titanium. However, Tao discloses (see, for example, Fig. 2c) a metallization stack structure comprising a pure copper layer 12a, and a doped copper cladding

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layer (implanted with titanium) 14a. In column 5, lines 5, lines 33-39, Tao discloses titanium as a metal dopant. It would have been obvious to one of ordinary skill in the art at the time of invention to have said copper layer having only an upper surface implanted with titanium in order to produce a higher electromigration resistance.

Regarding claim 75, see, for example, column 5, lines 25-28 wherein Tao discloses the doped cladding layer being 50 to 2,000 Å (thickness of about 50 Angstroms to about 200 Angstroms).

4. Claims 76 thru 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Okada '036 B1 in view of Tao et al. '802 as applied to claims 74, and 75 above, and further in view of Hsu et al. 5,661,082. Okada in view of Tao does not disclose a passivation layer formed in contact with said copper layer. However, Hsu discloses (see, for example, FIG. 10) a bond pad comprising an antireflective coating (passivation layer) 393. In column 3, lines 38-41, Hsu discloses the antireflective coating comprising silicon nitride. It would have been obvious to one of ordinary skill in the art at the time of invention to have a passivation layer formed in contact with said copper layer in order to protect the copper pad film and prevent reflection.

Regarding claim 77, see, for example, FIG. 10 wherein Hsu discloses a via formed in the antireflective coating.

Regarding claim 78, Okada in view of Tao does not disclose said dielectric film being formed of a material selected from the group consisting of phosphosilicate glass, borophosphosilicate glass, silicon oxide, silicon nitride, and silicon oxynitride. However, Hsu discloses (see, for example, FIG. 10) a bond pad comprising an insulating layer (dielectric film)

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36. In column 3, lines 14-17, Hsu discloses the insulating layer comprising phosphosilicate glass, and borophosphosilicate glass. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have said dielectric film being formed of a material selected from the group consisting of phosphosilicate glass, borophosphosilicate glass, silicon oxide, silicon nitride, and silicon oxynitride in order to have a material that provides an adequate base for the copper pad film.

5. Claims 79, 80, 82, and 83 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jang et al. 6,423,625 B1 in view of Harada et al. 5,565,378 in view of Mahulikar et al. 5,320,689. Jang discloses (see, for example, FIG. 10) an interconnect structure comprising a copper bonding pad (conductive bond pad) 82, and an AlCu layer 102. In column 3, lines 42-45, Jang discloses the pad has a thin Cu oxide layer. Jang does not disclose the titanium of the titanium-aluminum-copper nitrogen layer. However, Harada discloses (see, for example, column 6, lines 54-61) an aluminum alloy film, which may have titanium added. The metal element enhances the resistance to electromigration. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have the titanium of the titanium-aluminum-copper nitrogen layer in order to enhance the resistance to electromigration.

Jang in view of Harada does not disclose nitrogen of the titanium-aluminum-copper nitrogen layer. However, Mahulikar discloses (see, for example, abstract) a composite copper alloy wherein the copper alloy is formed with nitrogen. The copper alloy has improved tribological and mechanical properties while maintaining useful electrical conductivity. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention

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to have the nitrogen of the titanium-aluminum-copper nitrogen layer in order to improve tribological and mechanical properties while maintaining useful electrical conductivity.

Regarding claim 82, Jang in view of Harada in view of Mahulikar does not disclose said copper oxide layer having a thickness not greater than 300 Angstroms. However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the thickness of a copper oxide layer in order to adequately protect an underlying layer. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have said copper oxide layer having a thickness not greater than 300 Angstroms because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the thickness of a copper layer in order to adequately protect an underlying layer. See *In re Aller*, 105 USPQ 233.

Regarding claim 83, see, for example, column 3, lines 49-57 wherein Jang discloses an Au/Al ball (electrical conductor).

### ***Response to Arguments***

6. Applicant's arguments with respect to claims 74-80, 82, and 83 have been considered but are moot in view of the new ground(s) of rejection.

Regarding applicant's argument on page 9, last paragraph that a person of ordinary skill in the art would not have been motivated to combine the references absent the impermissible use of hindsight using the claims of the present application as a roadmap, this argument is not persuasive. It must be recognized that any judgement on obviousness is in any sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only

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knowledge which was within the level of ordinary skill at the time the invention was made, and does not include knowledge gleaned only from the Applicant's disclosure, such a reconstruction is proper. In re McLaughlin, 443 F. 2d 1392; 170 USPQ 209 (CCPA 1971). In this case, the addition of Harada, and Mahulikar to Jang all involve the improvement of a copper film by adding elements to the copper film. Clearly, Harada and Mahulikar provide reasons (see rejection above) so that such a reconstruction is proper (i.e. improve the properties of the copper film).

#### **INFORMATION ON HOW TO CONTACT THE USPTO**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 571-272-1733. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Eugene Lee  
May 10, 2006

A handwritten signature in black ink, appearing to be 'Eugene Lee', with a large loop at the end.

**EUGENE LEE  
PRIMARY EXAMINER**